PATENT SPECIFICATION

DRAWINGS ATTACHED

1,153,090

Date of Application and filing Complete Specification: 20 June, 1967.
No. 28294/67.
Application made in Switzerland (No. 9068) on 22 June, 1966.
Complete Specification Published: 21 May, 1969.

Index at acceptance:—A5 RX4; B3 K(2A4D, 2A4G, 2A4J, 8)

Int. Cl:—A 61 b 17/18

COMPLETE SPECIFICATION

Osteosynthetic Pressure Plates

We, SYNTHES AG, of 2, Steinbockstrasse, 7000 Chur, Switzerland, a joint stock company organised under the laws of Switzerland do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to osteosynthetic pressure plates in combination with countersunk head bore fixing screws.

In the practice of compression osteosynthesis the use of pressure plates has been known for a long time, as is evident from the relevant literature, for example the textbook "Technik der operativen Frakturenbehandlung" by Müller, Allgöwer and Willenegger (1963) page 53 *et seq.* Various types of plates are described therein and it is also explained why a considerable pressure effect must be exerted upon the two fracture surfaces. Furthermore the auxiliary means known to the practitioner for the production of pressure and the mode of use of these auxiliary means whereby the desired pressure is produced, are described. These auxiliary means constitute a clamp which must be screwed fast to the second bone fragment, and by the aid of which clamp the plate screwed to the first fragment can be drawn in in order that the two fragments can be pressed together. Then the plate is screwed to the second bone fragment, whereupon the clamp device is again removed. As is evident from this the proposed mode of use of a pressure plate is comparatively complicated and to allow for its correct securement it is necessary to have an operational wound which is substantially longer than the plate itself, as well as requiring additional damage to be inflicted upon the bone fragment for the fixing of the clamp. All these disadvantages are known to the practitioner. Furthermore it is also known that on account of the clearance necessary for screwing the plate to the second bone fragment, the screwed pressure plate when completed can exert only a fraction of the pressure which was exerted upon the fracture surface by means of the clamp.

The purpose of the present invention is to remove these disadvantages.

According to the invention there is provided an osteosynthetic pressure plate in combination with countersunk head bone-fixing screws, comprising a plate having a plurality of screw holes therein, at least one hole being formed as a countersunk slot having at one end thereof a ramped portion, the slot being so positioned and dimensioned that when one of the screws is driven into the bone at the ramped end of the slot, the plate is displaced in a direction for bringing the bone parts either side of the fracture into closer proximity, the slot being of a length to allow further displacement of the plate in said direction after displacement by the screw but before the screw is driven fully home.

Preferably, the end of the countersunk slot remote from the ramped portion forms an abutment stop adapted to the shape of the screw head. Each screw may have a hemispherical countersunk head and the ramped portion of the countersunk slot may be formed as a part cylindrical surface having an axis inclined to the plane of the plate. Alternatively each screw may have a conically shaped countersunk head and the ramped part of the countersunk slot may be formed as a part conical surface.

The plate may have said countersunk slots at each side of the position corresponding to the fracture point for increasing the pressure at the fracture point and may have at least two of the countersunk slots at at least one side of the position corresponding to the fracture point.

The invention will now be described with

reference to the practical examples shown in the accompanying drawings.

In the drawings:—

Fig. 1 is an enlarged section of a pressure plate and a tool used for making a countersink.

Fig. 2 is a plan view of the portion of the plate shown in fig. 1 after being worked by the tool shown therein.

Fig. 3 shows the tool used for making a displacement slot.

Fig. 4 shows a plan view of the plate portion represented in fig. 3 after being worked by the tool shown therein.

Figs. 5a to 5c show the same portion of the plate and a screw belonging thereto screwed into a bone fragment; more particularly

Fig. 5a shows the commencement of driving the screw.

Fig. 5b shows a further stage in the driving of the screw and

Fig. 5c shows the parts after the further displacement of the plate.

Fig. 6 shows on a smaller scale the manner in which two bone fragments can be held together and pressed together by means of a pressure plate.

Fig. 7 shows a further possibility of making a countersink intended for use with screws having a spherical seating surface on the head thereof.

Fig. 8 shows the corresponding manner of making the slot.

Fig. 9 shows the making of the countersink and the slot in one working operation for conical head screws.

Fig. 10 shows the finished slot with the screw sunk therein.

Figs. 1 to 4 show one method of making a pressure plate displacement slot in accordance with the invention, wherein the slot exhibits at the end remote from the fracture a ramped portion, and having at the other end, that is to say at the end nearer to the fracture, an abutment surface, such slots being intended for the countersunk screws having hemispherical bearing surfaces as represented in the figures 5a to 5c.

In all the figures the reference 1 indicates a portion of an osteosynthetic pressure plate in sectional view taken parallel to the longitudinal axis. For milling the countersink of the displacement slot there is employed the round headed miller 2 shown in fig. 1, whose axis 2a makes an angle α of, for example, 30° to 40° with respect to the normal n to the plate surface. This miller is first fed perpendicular to the plate surface, that is to say in the direction n of the normal to the plate, this motion continuing until the miller reaches the position represented in fig. 1 of the drawing, that is to say until the lower side of the plate is reached. The part cylindrical surface 3a so produced serves as the ramped portion of the countersink as will be further described below. Thereafter the miller 2 is displaced horizontally through the path a and subsequently is removed from the workpiece in direction n. In this manner there is formed the cavity represented in figs. 1 and 2, whose surface is indicated by the reference 3. Now the longitudinal slot 5 is milled by means of a cylindrical miller 4 as shown in fig. 3, so that of the surface 3, which was produced with the round headed miller 2, there remains now only a marginal surrounding strip, which comprises at one end of the slot 5 the part cylindrical surface 3a, and at the other end the part spherical surface 3b serving as an end abutment surface, whilst the intervening portions of the marginal strip are formed by part cylindrical surfaces 3c and 3d. This marginal strip exhibiting the general form of a countersink forms the seating for the hemispherical screw head 8a of the countersunk screw 8, as is evident from figs. 5a to 5c. These figures show on a larger scale the portion of fig. 6 indicated by the reference V.

In the latter figure there are shown two bone fragments 6 and 7 jointed together by a pressure plate 1. When screwing together the two parts first of all the plate 1 is fixed by means of a screw 10 to the fragment 6, the boring and tapping of the bone for the screw hole for the screw being effected in the known manner. Then the fractured portions of the bone fragments 6 and 7 are correctly assembled to each other and then, through the hole represented in figs. 5a to 5c a screw hole is bored and tapped for the screw 8 in the fragment 7, this being done in the manner shown in fig. 5a at that end of the displacement slot 5 remote from the fracture point 21. The head 8a of the screw 8 possesses, like all of the screws employed in fixing this plate, a hemispherical seating surface 8b. This surface, at the beginning of the driving of the screw, therefore bears upon the part cylindrical surface 3a of the countersink. Since, however, this surface has a part cylindrical shape, whose axis 2a forms an angle α with respect to the normal n, the plate 1 is pushed to the left upon driving the screw into the plate 1 until the screw surface assumes the position represented in fig. 5b. Thereby the two bone fragments 6 and 7 are pressed together, but screw 8 has not been finally driven home.

Now a screw 9, similar to the screw 8, is screwed in to adjacent screw hole whilst again the screw 9 is positioned at that end of the slot remote from the fracture 21. The driving of this screw likewise has the effect of displacing the plate relative to the bone fragment 7, whereby the pressure at the fracture 21 is further increased. Because the screw 8 was situated, before the driving of the screw 9, approximately in the

centre of its slot, the screw 8 does not obstruct the displacement of the plate relative to the fragment 7 in the direction to the left as shown in the drawing. After the driving of the screw 9 the screws 8 will be situated in a position relatively to the displacement slot as shown in fig. 5c. If the pressure at the fracture point is still too small, it is possible by screwing in a screw 11 to the fragment 6 to cause a displacement of the plate 1 relative to this fragment, and of course in such a direction as to increase the pressure at the fracture point.

The length of the individual slots in the pressure plate is therefore determined according to the number of screw holes provided for the operation of screwing the plate to a fragment and the amount of displacement afforded by the ramped part of the slot. In the practical example represented in figs. 5a to 5c it may be possible to achieve, by means of two screws at each side of the fracture 21, a satisfactory displacement of the plate relatively to the fragments, that is to say to produce the necessary compression force. If larger compression forces are required, that is to say a longer displacement path, then the distance *a* must be chosen correspondingly larger when making the slot. The same consideration applies when it is necessary for the plate to displace still further after fitting the screws in order to make possible a shortening of the fracture.

Figs. 7 and 8 show a further possible method for producing the correct shape of the countersink. The round head miller here shown by the reference 12 is placed with its axis 13 normal to the surface of the workpiece 14. For producing the ramped portion 15a of the countersink 15 the tool is now fed in, not vertically but obliquely and in the direction of the arrow 16 into the workpiece. As soon as the tool has assumed the position shown in fig. 7, that is to say when its apex has penetrated the entire thickness of the workpiece, the tool is displaced through the path length a parallel to the surface of the workpiece and is then removed from the workpiece in the vertical direction. By this operation there is obtained the same shape of the cavity as was obtained by the method described with reference to fig. 1. In a second working operation it is then also necessary to mill the slot by means of a cylindrical miller 17 as already described with reference to fig. 3.

Whilst the above described screw holes are intended for countersunk screws with hemispherical seating surfaces, it is obviously also possible to design the screw seating for screws having a part conical seating surface, as may be seen from figs. 9 and 10. Here there is employed a miller 18 with two cylindrical parts 18a and 18c as well as an interconnecting conical part 18b. This miller is fed during the machining of the workpiece in a vertical direction to such an extent until the upper edge of the conical part 18b lies in one plane with the surface of the workpiece. Then the tool is fed further in an oblique direction and in such a manner that the angle α which its direction of feed makes with the normal 19, is equal to the cone angle. The displacement of the tool in this direction should be taken at most so far until the lower edge of the conical part 18b of the tool lies in one plane with the lower surface of the workpiece. Thereupon the workpiece is displaced through the path d parallel to the surface of the workpiece, the length of path d corresponding to the length of path a in the first two practical examples, and also determining the length of the displacement path by which the plate can be pushed back and forth when the screw head 20 has been sunk to the position of fig. 10, in which it still does not rigidly clamp the plate.

Because the mode of a pressure plate, whose displacement slots are prepared by the method represented in fig. 9 differs only from the mode of use described with reference to figs. 5a to 5c in that the screws must now have a conical seating surface, whilst in the former case they have a spherical seating surface, it is unnecessary fully to repeat the foregoing description.

WHAT WE CLAIM IS:—

1. An osteosynthetic pressure plate in combination with countersunk head bone-fixing screws, comprising a plate having a plurality of screw holes therein, at least one hole being formed as a countersunk slot having at one end thereof a ramped portion, the slot being so positioned and dimensioned that when one of the screws is driven into the bone at the ramped end of the slot, the plate is displaced in a direction for bringing the bone parts either side of the fracture into closer proximity, the slot being of a length to allow further displacement of the plate in said direction after displacement by the screw but before the screw is driven fully home.

2. An osteosynthetic pressure plate in combination with the screws as claimed in claim 1, wherein the end of the countersunk slot remote from the ramped portion forms an abutment stop adapted to the shape of the screw head.

3. An osteosynthetic pressure plate in combination with the screws as claimed in claim 1 or 2, wherein each screw has a hemispherical countersunk head and the ramped portion of the countersunk slot is formed as a part cylindrical surface having an axis inclined to the plane of the plate.

4. An osteosynthetic pressure plate in combination with the screws claimed in claim 1 or 2, wherein each screw has a conically

shaped countersunk head and the ramped part of the countersunk slot is formed as a part conical surface.

5. An osteosynthetic pressure plate in combination with the screws as claimed in any one of the preceding claims, wherein the plate has said countersunk slots at each side of the position corresponding to the fracture point for increasing the pressure at the fracture.

6. An osteosynthetic pressure plate in combination with the screws as claimed in any one of the preceding claims, wherein the plate has at least two of the countersunk slots at at least one side of the position corresponding to the fracture.

7. An osteosynthetic pressure plate in combination with bone fixing screws and substantially as hereinbefore described with reference to Figs. 1 to 8 of the accompanying drawings.

8. An osteosynthetic pressure plate in combination with bone fixing screws and substantially as hereinbefore described with reference to Figs. 9 and 10 of the accompanying drawings.

DR. WALTHER WOLFF & CO.,
75, Victoria Street,
London, S.W.1.
Chartered Patent Agents,
Agent for the Applicant(s).

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1969.
Published by the Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

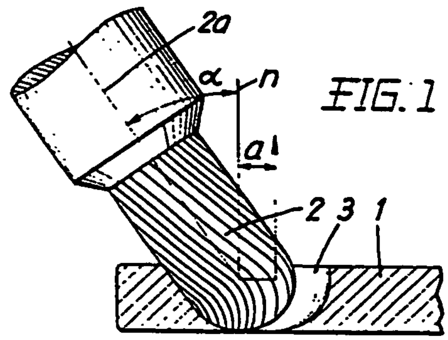
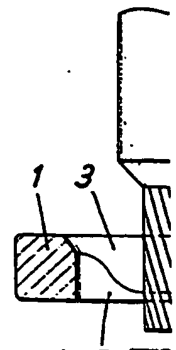


FIG.1



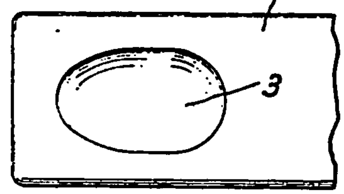
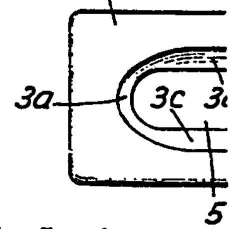
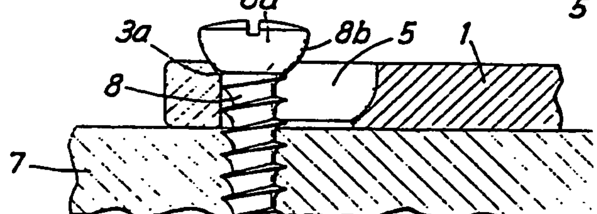
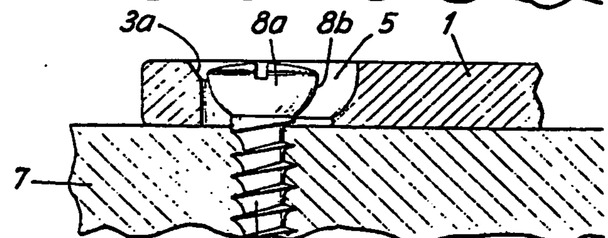
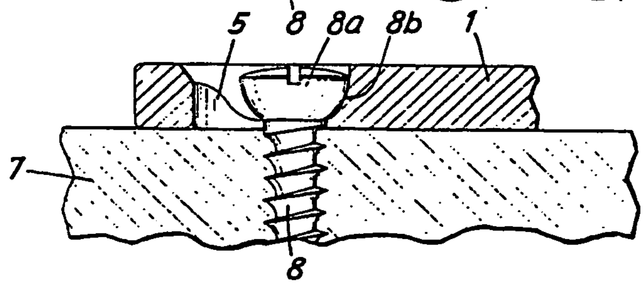


FIG.2







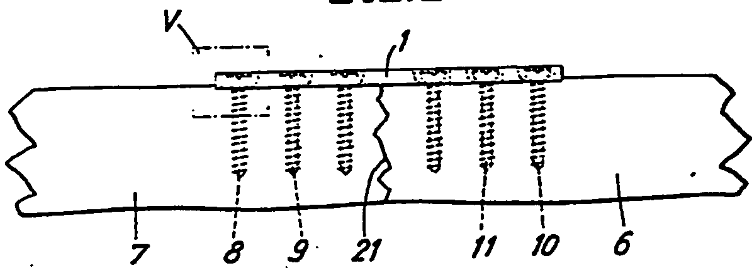


1153090 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheets 1 & 2

FIG.6



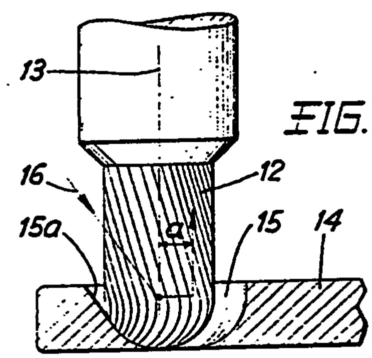


FIG.7

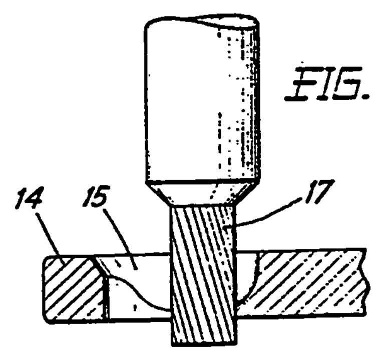


FIG.8

FIG.9

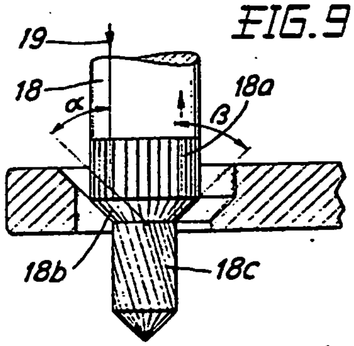
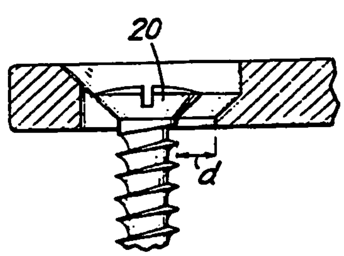


FIG.10



1153090 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2

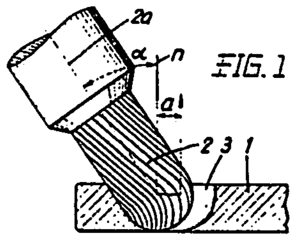


FIG.1

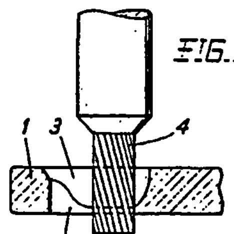


FIG.3

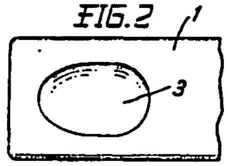


FIG.2

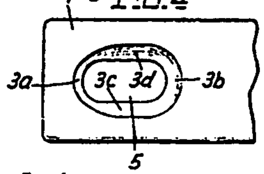


FIG.4

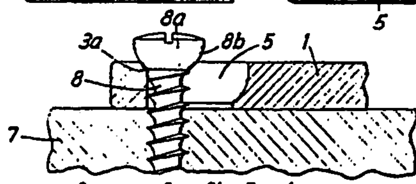


FIG.5a

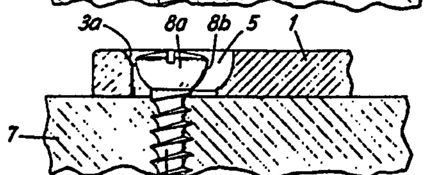


FIG.5b

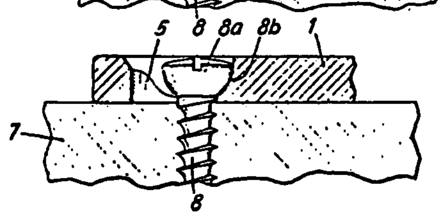


FIG.5c

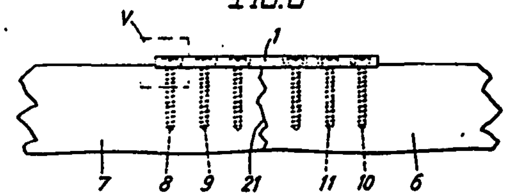


FIG.6

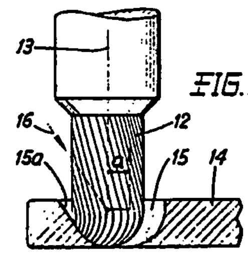


FIG.7

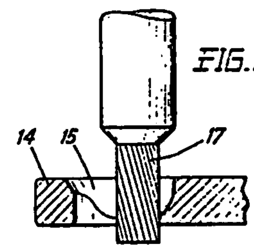


FIG.8

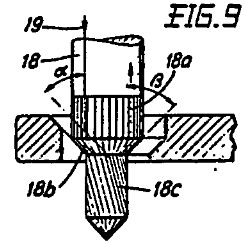


FIG.9

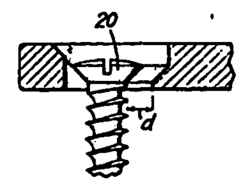


FIG.10